4. On some Foraminifera from the Miocene Deposits of Trinidad, West Indies. By R. J. Lechmere Guppy, C.M.Z.S.

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(Plate XLI.)

§ 1. *Introductory.*

A paper of mine on the Microzoic deposits of Trinidad was read before the Geological Society of London on the 8th June, 1892, and published in the November 1892 part of the Journal of the Society. Subsequently I communicated to a local scientific society of Trinidad a notice on the subject. But in these papers I did not deal with the novelties I had discovered in these rocks. Having been prostrated by a most serious illness I was unable for a long time to follow up the subject; and when I did so my work progressed but slowly. Hence I am only now in a position to make known some forms which appear to be new, and to bring forward some observations which may possibly throw light on the evolution of certain forms of the Foraminifera.

The species of Foraminifera have possibly as definite a form as most other species of organic beings. The amount of variation among what are called the higher animals is very great, as is shown by the fact that in some cases a single natural species has been made into a dozen or more by naturalists. We are not always acquainted with the limits of variation of a species, and we are often misled, or surprised and puzzled, by the occasional appearance and partial persistence of an embryonic condition which we do not understand; for example, the exceptional appearance of a specimen of *Frondicularia* or *Nodosaria* with a Cristellarian commencement. But in what are called the higher animals we are are not unfamiliar with the occurrence or persistence of what are known as embryonic characters. Such characters have thrown most valuable light upon the affinity and course of development of animals and plants. So they will probably do in the case of Foraminifera.

§ 2. *On the Initial Stage of* Frondicularia.

The specimen exhibited (Plate XLI. fig. 7) might, by some rhizopodists, be called *Lagena globosa*. It is in all essential respects similar to the specimens figured under that name by Sherborn and Chapman (Journ. R. Microsc. Soc. 1886, pl. xiv. figs. 11, 12). But my impression is that it is none other than the initial chamber of a *Polymorphina*. Messrs. Parker and Jones, in a memoir on North-Sea Foraminifera (Ann. & Mag. Nat. Hist. ser. 2, vol. xix. p. 273, 1857), perceived that the primordial segment of *Polymorphina* resembled a *Lagena*[1]. They remark of specimens of this kind

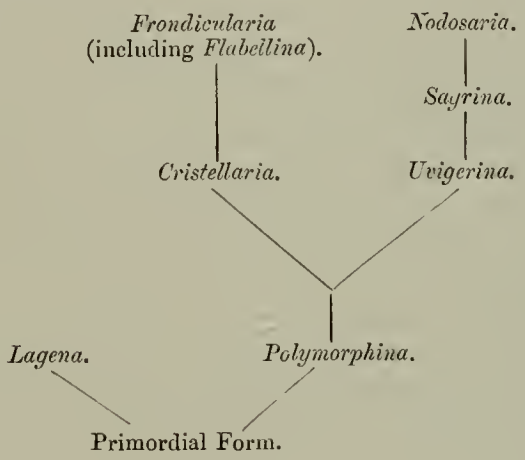
[1] See also the specimens figured by Reuss, 'Lagenideen,' pl. i. figs. 1–3. The figures of *L. globosa* in the 'Challenger' Report are true *Lagenæ*, and do not exhibit this form.

that "they exhibit an early condition of *Polymorphina*, in which we see an entosolenia, slightly modified, playing the part of the primordial chamber of this form. This entosolenian condition of *Polymorphina* is nearly always apparent in specimens sufficiently small or unadvanced to leave the early chambers translucent and open to examination. . . . . As they advance in growth the individual *Polymorphinæ* are invested with additional chambers after a type peculiar to themselves, but in a very irregular manner as regards the capacity and shape of the chambers."

If such a unicellular *Polymorphina* as the one shown in my fig. 7, or in Parker and Jones's figure just referred to, takes on additional chambers in a regular series on one side only instead of alternately on different faces of the shell, it becomes a *Cristellaria* either straight, curved, or involute. In further explanation it may be stated that in *Polymorphina* the chambers are developed alongside of, and adherent to, each other and the primordial chamber like drops of resin which have exuded from a tree. But if the chambers are developed in a single symmetrical and regular series, straight or curved, each segment being developed from and adherent to the preceding one only, the organism is a *Cristellaria*, and so may attain a considerable development in this shape. The Cristellarian segments are added consecutively on one side only of the previous segment, and may be represented as one of the branches of a letter V inverted, the aperture being at the one end (the apex) of the V; the other branch, in the case of a true *Cristellaria*, not being developed. If, however, at a certain stage, the other branch of the V becomes developed, the previous segment being embraced, not on one side only, as in the Cristellarian form, but on both sides, and the aperture being at the apex, we have a Flabelline *Frondicularia*. In this form, generally speaking, the segments are extremely compressed, the whole test being scarcely as thick as ordinary paper.

In fig. 1 (Plate XLI.) we have a shell with a Cristellarian beginning, passing into a *Nodosaria*. This may be called the *Amphycoryne*-form of *Nodosaria*, just as the specimen delineated in fig. 3 may be called the *Flabellina*-form of *Frondicularia*. The specimens figured illustrate the development of the genera to which we give the names of *Frondicularia* and *Nodosaria*, and suggest the conclusion that the primordial forms from which they were evolved resembled a *Lagena* and that the next steps of the evolution were represented by *Polymorphina* and *Cristellaria*. *Frondicularia* is no doubt the next step in one direction; whilst in another the evolution takes the line of *Nodosaria*. Hence it appears that *Nodosaria* is not directly developed from *Lagena*. The generic forms called *Polymorphina*, *Uvigerina*, and *Sagrina* intervene. We have thus an explanation of facts hitherto not quite easily explicable, namely, for example, the development of many Foraminifera from a more complex (biserial, triserial) form to a simpler (uniserial) form. In most individuals belonging to genera such as *Frondicularia* and others of the Nodosarian series

what may be called the embryonic development is hidden and masked within so small a space (generally a mere lump or boss) that its details cannot be made out. But here and there a specimen delays, as it were, the development of its mature form beyond the usual period, and enables us to catch a glimpse of the genealogy of the type. What I have endeavoured to express and explain in the preceding remarks may be represented in a tabular form as follows:—



This, of course, represents the development of the Nodosarian and Frondicularian series only. The biserial and triserial structure of the Textularians, Bulimines, &c. suggests that their development has lain through *Polymorphina* also. The Globigerine, Rotaline, and Milioline series may have risen from the same primordial form; but in these the course of development was different.

§ 3. *Descriptions of new Forms of Foraminifera.*

1. Stilostomella rugosa, nov. gen. et sp. (Plate XLI. figs. 10, 11.)

Test usually consisting of 3–4 (but occasionally more) nodosariform chambers, rather rapidly increasing. The axis is generally slightly arcuate. Texture rough. Aperture crescentic, often situated in a produced neck. Internally the aperture is furnished with a hollow conical process, shaped somewhat like a shoe-horn, the open side of the process being on the inner side of the crescentic aperture.

The shape of the shell is fairly represented by the figure of D'Orbigny's model of *Nodosaria radicula* given by Parker, Jones, and Brady in Ann. & Mag. Nat. Hist. ser. 3, xvi. 1865, pl. i. fig. 27. The last chamber is, however, often more produced and terminates in a neck, at the end of which is the aperture. The texture of the shell is apparently of the character of that of *Lagena aspera*, or of

the *Nodosaria* from the Naparima beds of Trinidad I have identified (rightly or not) with *N. rugosa*, D'Orb. Mr. Joseph Wright, F.G.S., gave it as his opinion that it was a new species of *Clavulina*; but the internal structure, including the hollow pillar, seems to suggest a relationship to *Ellipsoidina* and *Pleurostomella*.

From the Naparima Microzoic beds, Trinidad.

2. Ellipsoidina subnodosa, n. sp. (Plate XLI. fig. 12.)

Elongate, cylindrical, smooth, shining, generally tapering, having 4–12 chambers. Aperture crescentic, with a hooked and projecting lip and an internal hollow pillar.

Notwithstanding the resemblance in shape to a *Nodosaria*, this may generally be distinguished by its more regularly cylindrical shape, the separation between the chambers being less strongly marked than in most *Nodosariæ*. The aperture and interior structure are more distinct marks of difference. The species represents a close approach to *Pleurostomella*; but the aperture is not situated in a depression as it is in that genus, it is terminal or nearly so. Further, in our new species the segments rarely show a tendency to alternate as they do in *Pleurostomella*, though it is to be observed that in one or two specimens there is an indication of such a tendency near the apex. The aperture resembles that of *Ellipsoidina ellipsoides*, as represented by Brady's figure (Quart. Journ. Geol. Soc. vol. xliv. 1888, pl. i. fig. 1). Some specimens of *Pleurostomella subnodosa* come very close; see, for instance, the figures given by Burrows, Sherborn, and Bailey (Journ. R. Microsc. Soc. 1890, pl. viii. figs. 27–30). The shape varies from almost strictly cylindrical to subclavate and tapering. The texture is usually very close and fine and rather waxy-shining; but in what appear to be old specimens the surface becomes very finely roughened and seems to put on an arenaceous appearance. In this respect it makes an approach to *Stilostomella rugosa* (described above), whose aperture is somewhat similar.

Ellipsoidina subnodosa is a lengthened-out form of the type I have indentified as *E. exponens*, Brady, MS. (see Brady's remarks, quoted by Jukes-Browne and Harrison, Quart. Journ. Geol. Soc. 1892, p. 196). It is found in the Tertiary Microzoic rocks of Naparima, Trinidad.

3. Ellipsoidina exponens, Brady, MS. (Plate XLI. fig. 13.)

A smooth ovoid Foraminifer, having a crescentic aperture with a projecting hooked lip. The aboral end is generally smaller than the other extremity, and shows several successive chambers divided by very slightly sunk sutures.

It has the internal structure of *Ellipsoidina* (Ann. & Mag. Nat. Hist. ser. 4, vol. i. (1868), p. 333, pl. xiii.), and I believe it to be identical with the form so named by H. B. Brady, in Jukes-Browne and Harrison's paper on the Geology of Barbados (quoted under the foregoing description of *E. subnodosa*). It runs into forms near *E. ellipsoides*; indeed the three species (*E. subnodosa*, *E. exponens*,

and *E. ellipsoides*) may turn out to be only extreme variations of one species. *E. subnodosa* and *E. exponens* are found in the Tertiary Microzoic rocks of Naparima in Trinidad; and, as already stated, *E. exponens* is found in the oceanic deposits of Barbados. Brady truly remarks that it is more than probable that specimens belonging to the group may have been mistaken for forms of *Lagena*, *Glandulina*, and *Nodosaria*. I add that *Ellipsoidina* may be found to bear a somewhat similar relation to *Pleurostomella* that *Glandulina* does to *Nodosaria*.

4. Frondicularia flabelliformis, n. sp. (Plate XLI. figs. 5, 6.)

Test fan-shaped, widening rather rapidly, sometimes with angular projecting ends to the segments. The aperture is a narrow (linear) fissure between thickened everted and plaited or corrugated lips. The form delineated in fig. 6 is stouter and of more even outline, the ends of the segments not projecting. Some examples (not figured) have the ends of the segments very decidedly projecting.

This is wonderfully like *Pavonina flabelliformis*, which occurs with it in the Microzoic rocks of Naparima, Trinidad; so much so that at first I confounded the two, and sent specimens of the *Frondicularia* to the British Museum (Natural History) under the name of the *Pavonina*. But the aperture distinguishes it easily; and when once recognized there is no likelihood of one being mistaken for the other.

5. Gaudryina pariana, n. sp. (Plate XLI. figs. 21, 22.)

A *Gaudryina* of somewhat angular sectional contour. The triserial initial portion is triangular, the test afterwards taking on the biserial Textularian form. The test is roughened by minute sand-grains.

This species is very much smaller than the dimensions usually attained by other members of the genus, e. g. *G. pupoides*; and the other Foraminifera found in the same deposits are with certain exceptions also of small size. It is from the *Ditrupa*-bed of Pointapier, Trinidad.

6. Gaudryina lobata, n. sp. (Plate XLI. fig. 20.)

Test elongate, somewhat compressed, tapering, subarcuate, the chambers projecting in the form of lobulated segments. Aperture large, surrounded by a raised lip.

The nearest relation of this species is probably *G. baccata*, Schwager; but its segments are prominent and distinct. It also recalls *Bolivina lobata*, Brady. It occurs in the Microzoic rocks of Naparima, Trinidad.

7. Gonatosphæra prolata, nov. gen. et sp. (Plate XLI. figs. 14–19.)

Test a many-chambered somewhat prolate sphæroid, the initial end generally of rather smaller diameter than the other. Chambers

closely embracing. Sometimes each successive chamber embraces all the previous ones; in other cases some of the initial chambers are visible as indistinctly marked annular segments. A thread-like ridge, like a flange, surrounds the sphæroid in the direction of its length. This ridge, which often appears to be double, expands at the larger end of the test, and its two elements separating, leave between them a fissurine aperture. This is an elongated narrow opening between two pouting lips, the lips being a continuation and extension of the ridge or flange. Many specimens show a ridge at right angles to the longitudinal ridge; but this is produced by the breaking-away of the last chamber at the line of suture.

This singular organism appears to differ in some essential characters from any Foraminifer hitherto known, at least so far as I have been able to find out. It varies in shape from an almost perfect sphere to a sphæroid of very prolate shape, the initial (aboral) end being sometimes a very rounded and blunt projection. The longitudinal ridge is sometimes obsolete towards the aboral pole, sometimes it is single, and occasionally it is triple, the two lateral elements being the most raised. In shape the test resembles a very round *Glandulina*, like *G. obtusissima*, Reuss (Tert. Foram. Fauna, 1863, pl. viii. fig. 93; also *G. globulus*, figs. 94, 95), or *G. abbreviata*, Neug. (Sherborn and Chapman, London Clay Foram., Journ. Microsc. Soc. 1886, pl. xiv. fig. 20), or a *Lagena* like *L. obtusa*, Egg. (Reuss, 'Lagenideen,' 1862, pl. vii. figs. 92, 93). The test is hyaline, glistening, and very fine and close-grained in texture.

It has only been found in the *Ditrupa*-bed of Pointapier, Trinidad.

EXPLANATION OF PLATE XLI.

Fig. 1. Amphicoryne-form of *Nodosaria hispida*, D'Orb., var.

2. *Cristellaria aculeata*, D'Orb., var. A form found abundantly in the *Ditrupa*-bed of Pointapier, Trinidad. Closely allied to *C. wetherellii*, Jones, and *C. fragaria*, Gümb. Compare also *Marginulina cristellarioides*, Gümb. For comparison with fig. 1.

3. *Frondicularia complanata*, Defr. Flabelline variety showing Cristellarian initial portion.

4. *Frondicularia alata*, D'Orb. (*complanata*, Defr.). Specimen showing (*a*) Cristellarian initial portion, and (*b*) portion reproduced after loss by fracture of the original oral portion.

5. *Frondicularia flabelliformis*, n. sp. Usual form. In many specimens the ends of the chambers project more than is shown in this drawing

6. *Frondicularia flabelliformis*, n. sp. A thicker and stouter form than the preceding. This may be compared with *F. spissa*, Terquem (Rupert Jones, 'Monthly Microscopical Journal,' 1876, pl. cxxviii. fig. 24).

7. Initial segment of *Polymorphina*, comparable with *Lagena globosa*, Mont.

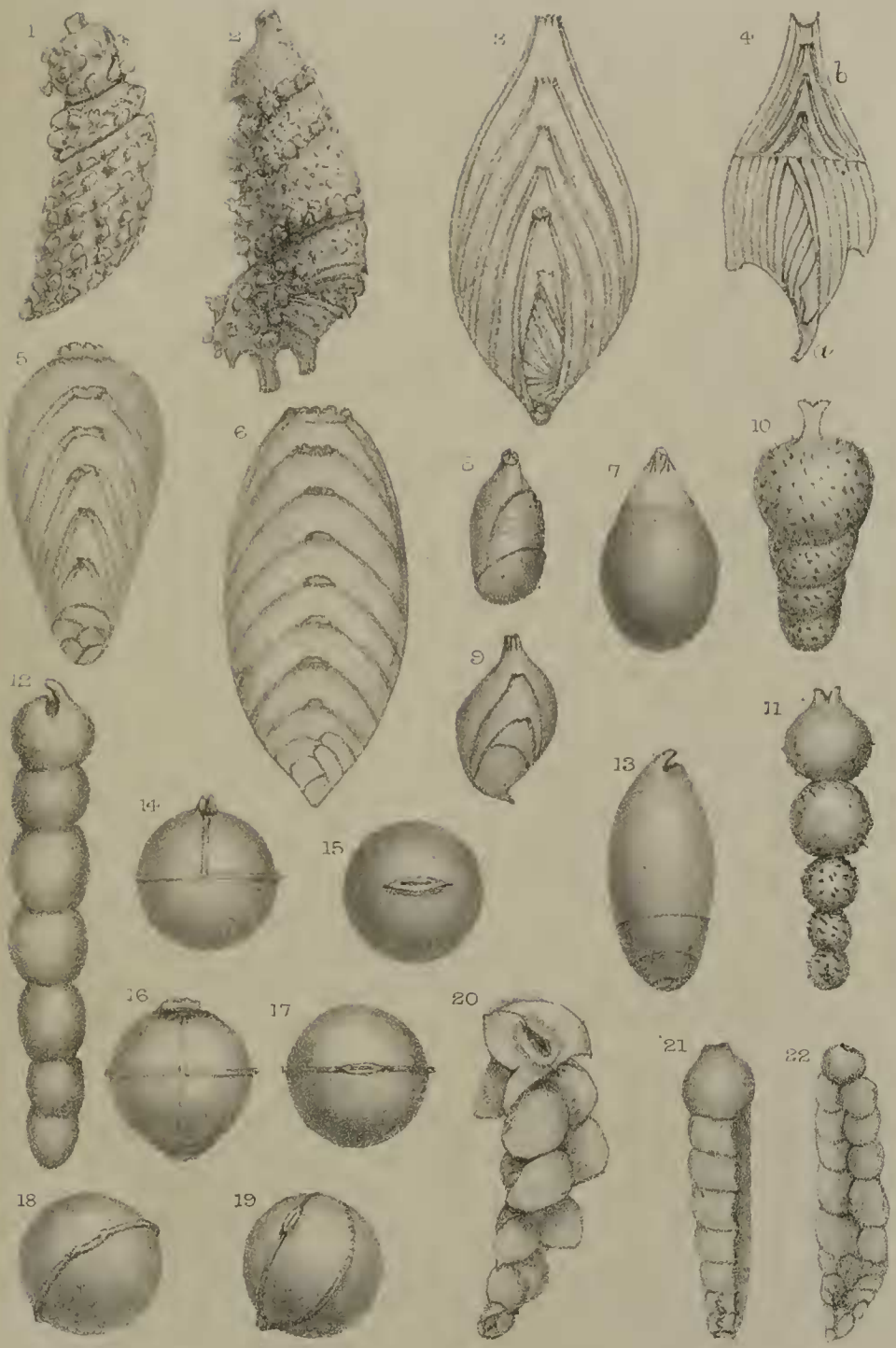
8, 9. Specimens showing the development of *Frondicularia* from a *Polymorphina* segment. These may be compared with *Flabellina ponderosa* and *triquetra*, Terquem (Rupert Jones, 'Monthly Microscopical Journal,' 1876, pl. cxxviii. figs. 25, 26).

10. *Stilostomella rugosa*, n. sp. A specimen with a protuberant neck.

11. The same. A specimen with a less protuberant neck.

12. *Ellipsoidina subnodosa*, n. sp.

13. *Ellipsoidina exponens*, Brady, MS.



L.L.Walter del.
F.H.Michael lith

West, Newman imp.

Foraminifera from the microzoic deposits of Trinidad.